

Rec'd (3)

04 JAN 2009

10/519401
REPLACED BY
ART 34 AMDT

drawbacks that conditions for the cleaning are not established such that the cleaning thereof is not performed efficiently.

5 Detailed Description of the Invention

Therefore, the present invention has been made to ameliorate the above-described disadvantages. In other words, it is an object of the present invention to provide a
10 method of cleaning substrate-processing apparatus which performs a process on a substrate, and the substrate-processing apparatus to which a cleaning process may be performed.

A method of cleaning a substrate-processing apparatus
15 in accordance with the present invention, the method includes the steps of: after processing a substrate placed in an inner chamber of a substrate processing apparatus, elevating a temperature of the inner chamber higher than that when processing thereof; exhausting a space between the
20 inner chamber and an outer chamber that accommodates the inner chamber; supplying a cleaning gas into the inner chamber; and removing substances to be cleaned off which are adhered to an inside of the inner chamber. The cleaning method of the substrate-processing apparatus in accordance
25 with the present invention includes the cleaning steps described above, so that the cleaning can be performed

efficiently. Further, a temperature of the outer chamber may be prevented from being elevated.

5 The cleaning steps thereof are preferably to be performed while cooling the outer chamber. By cooling the outer chamber, a temperature of the outer chamber can be prevented from being elevated.

The outer chamber is preferably made of metals. By making the outer chamber of metals, a mechanical strength of the substrate-processing apparatus can be increased.
10 Further, this facilitates the maintenance of a vacuumed status.

The cleaning method thereof is preferably performed by spreading a cleaning gas along a surface of a substrate-supporting member which supports the substrate accommodated
15 into the inner chamber. By supplying the cleaning gas thereto, a ratio of the cleaning gas colliding with the substrate-supporting member may be increased, compared with a case of supplying the cleaning gas toward the substrate-supporting member from upside of the substrate-supporting
20 member, thereby capable of removing a lot more substances to be cleaned off from the substrate-supporting member.

Another method of cleaning a substrate-processing apparatus in accordance with the present invention, the method includes the steps of: after processing a substrate
25 placed in an inner chamber of a substrate processing apparatus, providing a temperature difference between a

chamber and a substrate-supporting member which supports the substrate; supplying a cleaning gas into the chamber; and removing substances to be cleaned off adhered to an inside of the inner chamber. The method of cleaning the substrate-processing apparatus in accordance with the present invention includes the cleaning steps described above, so that the cleaning can be performed efficiently.

It is preferable that the processing of the above-described substrate is performed while a temperature of the chamber is lower than that of the substrate-supporting member and the cleaning steps thereof are performed while a temperature of the chamber is lower than that of the substrate-supporting member. For the case of performing the cleaning process under an above-described state, the substances to be cleaned off can be efficiently removed.

The above-described cleaning process is preferably performed by heating the chamber to a temperature of being higher than or equal to 350 °C and heating the substrate-supporting member to a temperature of being higher than or equal to 400 °C. By performing the cleaning process under an above-described state, the substances to be cleaned off can be securely removed therefrom.

The cleaning process thereof is preferably performed by spreading a cleaning gas along a surface of a substrate-supporting member. By supplying the cleaning gas thereto like this, a ratio of the cleaning gas colliding with the

while collecting the by-products which have been generated by a chemical reaction between the substances to be cleaned off and the cleaning gas. By performing the exhaust thereof while collecting the by-products, it is possible to prevent
5 the by-products from being adhered into the gas exhaust unit which is used when cleaning thereof.

The collection of the above-described by-products is preferably performed at a place close to the inner chamber or the chamber. By performing the collection at the places
10 described above, it is possible to further prevent the by-products from being adhered into the gas exhaust unit which is used when cleaning thereof.

The above-described inner chamber or the chamber may be heated up by a resistance heating element. By employing
15 the resistance heating element, it is possible to readily heat the inner chamber or the chamber to a predetermined temperature.

The above-described inner chamber or the chamber may be heated up by a heating lamp. By using the heating lamp,
20 it is possible to elevate the temperature of the inner chamber or the chamber to a predetermined level in a short time.

A substrate-processing apparatus in accordance with the present invention includes: an inner chamber; an outer
25 chamber accommodating the inner chamber therein; a cleaning gas supplying unit for providing a cleaning gas to an inside

of the inner chamber; a chamber heater for heating the inner chamber; and an exhaust unit for exhausting a space between the inner chamber and the outer chamber. The substrate-processing apparatus in accordance with the present invention includes the cleaning gas supplying unit, the chamber heater and the exhaust unit, thereby capable of cleaning an inside of the inner chamber. Further, a temperature of the outer chamber can be prevented from being elevated.

10 The above-described chamber heater is preferably installed into a space between the inner chamber and the outer chamber. By installing the chamber heater at the position described above, the inner chamber can be securely heated. Further, since the space between the inner chamber and the outer chamber is exhausted, the heat from the chamber heater is prevented from being easily transferred to the outer chamber, thereby securely preventing the temperature of the outer chamber from being elevated.

20 The above-described substrate-processing apparatus preferably further includes a reflecting body which guides a heat ray into the inner chamber, the heat ray being irradiated from the chamber heater. By including the reflecting body, the inner chamber can be efficiently heated.

25 The above-described outer chamber includes a heat ray transmitting window which transmits the heat ray which is irradiated from the chamber heater, which may be installed

outside of the outer chamber. By equipping the outer chamber with the heat ray transmitting window and installing the chamber heater at the position described above, it may be facilitated to perform a maintenance of the chamber, i.e.,
5 a repairing and a cleaning thereof.

Brief Description of the Drawings

Fig. 1 shows a structure of a substrate-processing
10 apparatus in accordance with a first embodiment of the present invention;

Fig. 2 presents an inside of a processing vessel schematically in accordance with the first embodiment of the present invention;

15 Fig. 3 illustrates a flow chart of film-forming which is performed by the substrate-processing apparatus in accordance with the first embodiment of the present invention;

Fig. 4 depicts a flow chart of cleaning which is
20 performed by the substrate-processing apparatus in accordance with a first embodiment of the present invention;

Fig. 5A illustrates a chemical structure of Hhfac schematically, and Fig. 5B represents a chemical structure of a metal complex which is formed by Hhfac schematically;

25 Fig. 6 represents a figure of a substrate-processing apparatus in accordance with a comparative example;

What is claimed is:

1. A method of cleaning a substrate-processing apparatus, comprising the steps of:

5 after processing a substrate placed in an inner chamber of a substrate processing apparatus, elevating a temperature of the inner chamber higher than that when processing thereof;

10 exhausting a space between the inner chamber and an outer chamber that accommodates the inner chamber;

supplying a cleaning gas into the inner chamber; and removing substances to be cleaned off which are adhered to an inside of the inner chamber.

15 2. The cleaning method of claim 1, wherein the steps are performed while cooling the outer chamber.

3. The cleaning method of claim 1, wherein the outer chamber is made of metals.

20

4. The cleaning method of claim 1, wherein the cleaning gas is spread along a surface of a substrate-supporting member which supports the substrate accommodated into the inner chamber.

25

5. The cleaning method of claim 1, wherein the cleaning

gas includes ketone.

6. The cleaning method of claim 5, wherein ketone is β -diketone.

5

7. The cleaning method of claim 6, wherein β -diketone is hexafluoroacetylacetone.

8. The cleaning method of claim 1, wherein the
10 temperature of the inner chamber is higher than that of the inner chamber when processing a substrate by more than or equal to 100 °C.

9. The cleaning method of claim 1, wherein the inner
15 chamber is made of quartz or ceramics.

10. The cleaning method of claim 1, wherein the substances to be cleaned off are oxides containing at least one element selected from the group consisting of Al, Y, Zr, Hf, La, Ce
20 and Pr.

11. The cleaning method of claim 1, wherein the cleaning gas includes an active species.

12. The cleaning method of claim 1, wherein the cleaning
25 method is performed while exhausting an inside of the inner

chamber.

13. The cleaning method of claim 12, wherein the
exhausting of the inside of the inner chamber is performed
5 by using a different exhausting system from the exhausting
system which is used for processing the substrate.

14. The cleaning method of claim 12, wherein the
exhausting of the inside of the inner chamber is performed
10 while collecting a by-product which is generated from a
chemical reaction between the substances to be cleaned-off
and the cleaning gas.

15. The cleaning method of claim 14, wherein the
15 collecting of the by-product is performed at a position
close to the inner chamber.

16. The cleaning method of claim 1, wherein the inner
chamber is heated by a resistance heating element.

20

17. The cleaning method of claim 1, wherein the inner
chamber is heated by a heating lamp.

18. A method of cleaning a substrate-processing apparatus,
25 comprising the steps of:

after processing a substrate placed in an inner

chamber of a substrate processing apparatus, providing a temperature difference between a chamber and a substrate-supporting member which supports the substrate;

supplying a cleaning gas into the chamber; and

5 removing substances to be cleaned off which is adhered to an inside of the inner chamber.

19. The cleaning method of claim 18, wherein the processing of the substrate is performed while a temperature
10 of the chamber is lower than that of the substrate-supporting member and the method of cleaning is performed while a temperature of the chamber is lower than that of the substrate-supporting member.

15 20. The cleaning method of claim 18, wherein the cleaning method is performed by heating the chamber to a temperature of being higher than or equal to 350 °C and heating the substrate-supporting member to a temperature of being higher than or equal to 400 °C.

20 21. The cleaning method of claim 18, wherein the cleaning method is performed by spreading the cleaning gas along a surface of the substrate-supporting member.

25 22. The cleaning method of claim 18, wherein the cleaning gas includes ketone.

23. The cleaning method of claim 22, wherein ketone is β -diketone.

5 24. The cleaning method of claim 23, wherein β -diketone is hexafluoroacetylaceton.

25. The cleaning method of claim 18, wherein the temperature of the inner chamber is higher than that during
10 processing of the substrate by more than or equal to 100 °C.

26. The cleaning method of claim 18, wherein the inner chamber is made of quartz or ceramics.

15 27. The cleaning method of claim 18, wherein the substances to be cleaned off are oxides containing at least one element selected from the group consisting of Al, Y, Zr, Hf, La, Ce and Pr.

20 28. The cleaning method of claim 18, wherein the cleaning gas includes an active species.

29. The cleaning method of claim 18, wherein the cleaning method is performed while exhausting an inside of the
25 chamber.

30. The cleaning method of claim 29, wherein the exhausting of the inside of the inner chamber is performed by using a different exhausting system from that used for processing the substrate.

5

31. The cleaning method of claim 29, wherein the exhausting of the chamber is performed while collecting by-products which are generated from a chemical reaction between the substances to be cleaned-off and the cleaning gas.

10

32. The cleaning method of claim 18, wherein the collecting of the by-products is performed at a position close to the inner chamber.

15

33. The cleaning method of claim 18, wherein the chamber is heated by a resistance heating element.

34. The cleaning method of claim 18, wherein the chamber is heated by a heating lamp.

20

35. A method for cleaning a substrate-processing apparatus, comprising the steps of:

accommodating the substrate into the chamber of the substrate processing apparatus;
processing the substrate;

25

elevating a temperature of the chamber higher than that during the processing of the substrate;

supplying a cleaning gas having Ketone into the chamber; and

5 removing substances to be cleaned off which are adhered to an inside of the chamber.

36. The cleaning method of claim 35, wherein the method is performed by spreading the cleaning gas along a surface of
10 the substrate-supporting member.

37. The cleaning method of claim 35, wherein ketone is β -diketone.

15 38. The cleaning method of claim 37, wherein β -diketone is hexafluoroacetylaceton

39. The cleaning method of claim 35, wherein the temperature of the chamber is higher than that during the
20 processing of the substrate by more than or equal to 100 °C.

40. The cleaning method of claim 35, wherein the chamber is made of quartz or ceramics.

25 41. The cleaning method of claim 35, wherein the substances to be cleaned off are oxides containing at least

one element selected from the group consisting of Al, Y, Zr, Hf, La, Ce and Pr.

42. The cleaning method of claim 35, wherein the cleaning
5 gas includes an active species.

43. The cleaning method of claim 35, wherein the cleaning
method is performed while exhausting an inside of the
chamber.

10

44. The cleaning method of claim 43, wherein the
exhausting of the inside of the inner chamber is performed
by using a different exhausting system from that used for
processing the substrate.

15

45. The cleaning method of claim 43, wherein the
exhausting of the inside of the chamber is performed while
collecting by-products which are generated from a chemical
reaction between the substances to be cleaned-off and the
20 cleaning gas.

25

46. The cleaning method of claim 45, wherein the
collecting of the by-products is performed at a position
close to the chamber.

47. The cleaning method of claim 35, wherein the chamber

is heated by a resistance heating element.

48. The cleaning method of claim 35, wherein the chamber is heated by a heating lamp.

5

49. A substrate-processing apparatus, comprising:
an inner chamber;
an outer chamber accommodating the inner chamber;
a cleaning gas supplying unit for providing a cleaning
10 gas to an inside of the inner chamber;
a chamber heater for heating the inner chamber; and
an exhaust unit for exhausting a space between the
inner chamber and the outer chamber.

15 50. The substrate-processing apparatus of claim 49,
wherein the chamber heater is installed between the inner
chamber and the outer chamber.

20 51. The substrate-processing apparatus of claim 49,
further comprising a reflecting body which guides a heat ray
into the inner chamber, the heat ray being irradiated from
the chamber heater.

25 52. The substrate-processing apparatus of claim 49,
wherein the outer chamber has a heat ray transmitting window
which transmits the heat ray irradiated from the chamber

heater, and the chamber heater is installed outside of the outer chamber.